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Method for Adjusting a Volumetric Flow-Variable Positive Displacement Pump in an Internal Combustion Engine

The invention relates to a method for adjusting a volumetric flow-variable positive displacement pump in an internal combustion engine.

Such positive displacement pumps are used in internal combustion engines chiefly as lubricant pumps for oil lubrication (e.g., US-A-5800131). It is known that the adjustment of such positive displacement pumps is effected either mechanically, hydraulically, mechanically-hydraulically or electro-hydraulically. Adjustment of a volumetric flow-variable positive displacement pump is understood as meaning the reduction or increase of its displacement space. For this purpose, in a volumetric flow-variable vane pump, the axial offset of the rotating rotor relative to the center of the pump is changed in such a way that the individual displacement spaces present between the vanes are increased or reduced. The changing of the axial offset is referred to as adjustment. The adjustment of a pump is carried out when either the plant pressure is to be varied or the delivery has to be adapted.

It is the object of the invention to provide a method by means of which a volumetric flow-variable positive displacement pump can be optimally adapted to changing needs of an internal combustion engine.

This object is achieved, according to the invention, by a method which has the features of claim l.

In this method according to the invention, a marked characteristic of the internal combustion engine is determined and, depending on the deviation of this characteristic from an actual value signal, the positive displacement pump is adjusted until the characteristic has been made equivalent to the setpoint value. The suction pressure (p_S), the delivery pressure (p_L), the speed (n) of the internal combustion engine and/or of the positive displacement pump, the temperature (T) of the fluid and/or the delivery rate (Q) of the fluid can be determined as the characteristic. This means that it is also possible to have a plurality of different characteristics to determined and, depending on this plurality of characteristics, the positive displacement pump can be controlled. The plurality of characteristics can be polled simultaneously or successively. Moreover, the setpoint value can be made available in the form of setpoint value ranges so that only a deviation of a certain magnitude leads to an adjustment of the positive displacement pump. This can be set in such a way that, for example, a deviation of 5% from the setpoint value leads to an adjustment of the positive displacement pump, whereas deviations below this limit are not taken into account.

Another variant provides for a change of the volumetric flow only when the adjusting signal changes by a certain value. This may be 5% or 10%.

The motor control computer which is already present and in which a large number of characteristic data are already processed can be used as a

controller. The motor control computer then need only be supplemented with the data of the positive displacement pump and the calculation rules for the setpoint value/actual value comparison and for the signal generation. Thus, there is no need for either additional sensors or additional cables, so that relatively few components are required.

The final control element is preferably actuated against a restoring force. The delivery volume of the positive displacement pump is reduced thereby. This has the substantial advantage that, on failure of the control chain of an individual component, the positive displacement pump is adjusted to maximum volumetric flow by means of the restoring spring which resets the positive displacement pump to the starting position.

Further advantages, features and details of the invention are evident from the following description, in which a particularly preferred embodiment is described in detail with reference to the drawing. The features shown in the drawing and mentioned in the description and in the claims may be essential to the invention either individually or in any desired combination. The drawing shows a circuit diagram of a preferred embodiment of the invention.

A positive displacement pump which is driven by an internal combustion engine 2 is denoted by the reference numeral 1. The positive displacement pump 1 suctions the oil from an oil sump 3 and delivers it to a large number of lubricant points 4 in the internal

combustion engine 2, of which only one is shown. The oil runs from the lubricant points 4 back into the oil sump 3.

The method according to the invention makes use of the measuring points 5 present in the engine system for determining the delivery pressure PL, the delivery rate Q, the temperature T, the suction pressure p_s and the speed n as actual value signals for processing in a controller 6. The sensors already present and laid cables are used. Moreover, the motor control computer already present is used and optionally supplemented. Required data for the measuring points 5 for the respective operating state of the engine are stored in this controller 6 for the operating range of the engine 2. The actual value signals determined at the measuring points 5 are compared in the controller with the required data stored there. In the controller 6, an adjusting signal is generated from the deviations between the actual values and the setpoint values and is transmitted via a signal transmitter 7 to a final control element 8. An increase or reduction of the displacement space of the positive displacement pump 1 is effected by the final control element 8 on the basis of the adjusting signal until the actual value signals at the measuring points 5 correspond to the setpoint value signals in the controller 6. Suitable control systems are used for this purpose.

It should be pointed out that the measuring points 5 shown in the drawing can be used, but that it is also possible to use fewer measuring points 5 or further additional measuring points 5. The controller 6 may be present as an individual apparatus or, as mentioned above, it is

integrated in the motor control computer. In this case, it is merely necessary to additionally store data for the positive displacement pump 1 and the calculation rules for the setpoint value/actual value comparison and the signal control generation. The signal transmitter 7 can likewise be in the form of an individual apparatus, or it is integrated into the controller 6 or into the final control element 8.

The final control element 8 is in the form of a discrete component or is already integrated in the positive displacement pump 1. The final control element 8 contains a restoring spring 9 which opposes the direction of adjustment and serves, on failure of the control chain formed from the measuring points 5, the controller 6, the signal transmitter 7 and the final control element 8, or of an individual component thereof, for ensuring the adjustment of the positive displacement pump 1 to the greatest chamber volume. Malfunctions and undersupply of the internal combustion engine 1 with lubricant are thereby avoided.